Mock Test
GATE
MECHANICAL ENGINEERING

GATE Assessment Test

National Institute of Technology, Srinagar

Instructions

Maximum Marks:100 **Duration: Three Hours**

Read the following instructions carefully.

- There are a total 65 questions carrying 100 marks.
- Q.1 to Q.25 are 1-mark questions. Q.26 to Q.55 are 2-marks questions.
- Q.56 to Q.60 are 1-mark questions.Q.61 to Q.65 are 2-marks questions.
- Un-attempted questions will carry zero marks.
- There will be **no negative** marking for Numerical Answer Type (NAT) Questions.
- There will be **negative** marking for Multiple Choice Questions (MCQs).
- MCQs carrying 1 marks each, 1/3 marks would be deducted for marking an incorrect answer.
- MCQs carrying 2 marks each, 2/3 marks would be deducted for marking an incorrect answer.

Want to know your score and question wise result with answers Key & solution (within 40 sec. at your email)**,**
Please submit the answers in google form. (google form link given with this paper email)
Email for link: smartidentitycard@gmail.com

Q.1 to Q.25 carry one mark each.

Q.1 Let A be a square matrix of order n and Δ denotes $\det(A)$, then $\det(2A)$ is equal to

(A) $2^n\Delta$ (B) $2n\Delta$ (C) 2Δ (D) $\dfrac{\Delta}{2^n}$

Q.2 If A and B are matrices of order 4×4 such that $A = 5B$ and $|A| = \alpha \cdot |B|$, then α is _____.

Q.3 If the vector $\mathbf{F} = (x+2y+az)\mathbf{i} - (2x+3y+z)\mathbf{j} + (4x-y+2z)\mathbf{k}$ is irrotational, then

(A) $a = 4$ (B) $a = -2$ (C) $a = -1$ (D) $a = 2$

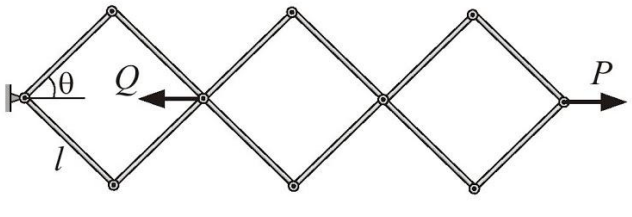
Q.4 The family of straight lines passing through the origin is represented by the differential equation

(A) $ydx + xdy = 0$ (B) $xdx + ydy = 0$ (C) $xdy - ydx = 0$ (D) $ydy - xdx = 0$

Q.5 The complex numbers $z = x + iy$ which satisfy the equation $|z+1| = 1$, lie on

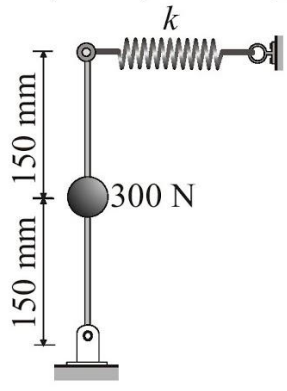
(A) y-axis (B) x-axis (C) circle with center $(-1,0)$ and radius 1 (D) None of these

Q.6 Figure shows the system of linkage under the static equilibrium. Which one of the following option is true?



(A) $P = Q$ (B) $P = 3Q$ (C) $3P = Q$ (D) $P = 2Q$

Q.7 A uniform stiff rod of length 300 mm and having a weight of 300 N is pivoted at one end and connected to a spring at the other end (See figure). For keeping the rod vertical in a stable position the minimum value of spring constant k (in N/m) needed is_____.

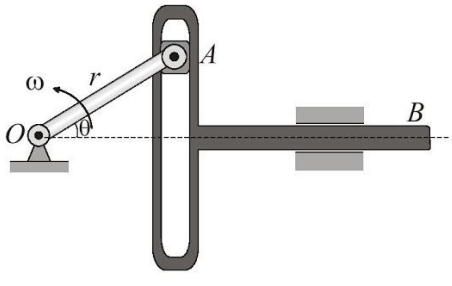


Q.8 A uniformly distributed load ω (in kN/m) is acting over the entire length of a 3 m long cantilever beam. If the shear force of the midpoint of cantilever is 6 kN, what is the value of ω ?_____.

Q.9 A long rod of length L, cross-section area a, density ρ and modulus of elasticity E hangs vertically from a roof. The maximum longitudinal strain in the rod is

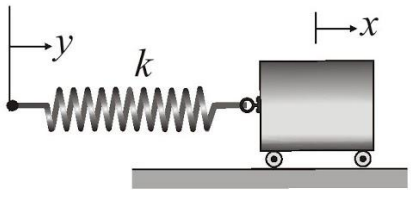
(A) $\frac{\rho g L^2}{E}$ (B) $\frac{\rho g L^2}{2E}$ (C) $\frac{2\rho g L^2}{E}$ (D) 0

Q.10 Figure shows the Scotch-Yoke mechanism. The velocity of point B in the position shown, is



(A) $\omega r\cos\theta$ (B) $\omega r\sin\theta$ (C) $\omega r(\cos\theta+\sqrt{1-\cos\theta})$ (D) None of these

Q.11 The differential equation of motion for the system shown in the figure is

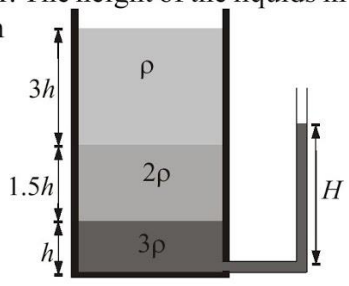


(A) $m\frac{d^2x}{dt^2}+kx=ky$ (B) $m\left(\frac{d^2x}{dt^2}-\frac{d^2y}{dt^2}\right)+kx=0$ (C) $m\frac{d^2x}{dt^2}+ky=0$ (D) $m\frac{d^2x}{dt^2}+kx=0$

Q.12 Two identical ball bearings P and Q are operating at loads 30 kN and 45 kN respectively. The ratio of the life of bearing P to the life of bearing Q is

(A) $\frac{81}{16}$ (B) $\frac{9}{4}$ (C) $\frac{27}{8}$ (D) $\frac{3}{2}$

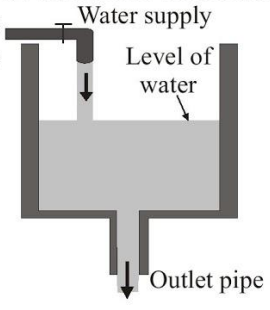
Q.13 Three immiscible liquids of specific density ρ, 2ρ and 3ρ are kept in a jar. The height of the liquids in the jar and at the piezometer fitted to the bottom of the jar are as shown in the given figure. The ratio of $\frac{H}{h}$ is



(A) 4 (B) 3.5

(C) 3 (D) 2.5

Q.14 Water is supplied to a tank at the rate of 0.02 m^3/s, as shown in the figure below. The cross-sectional area of the tank is 1 m^2 and the inner diameter of the outlet pipe is 60 mm. At a time when the water level in the tank is increasing at the rate of 5 mm/s, the average velocity (in m/s) of water in the outlet pipe is approximately



(A) 0.005

(B) 0.06

(C) 5.3

(D) 20

Q.15 In a long cylindrical rod of radius r and a surface heat flux of q_0, the uniform internal heat generation rate is

(A) $\frac{2q_0}{r}$ (B) $2q_0$ (C) $\frac{q_0}{r}$ (D) $\frac{q_0}{r^2}$

Q.16 The equation of effectiveness $\varepsilon = 1 - e^{-NTU}$ of a heat exchanger is valid in the case of

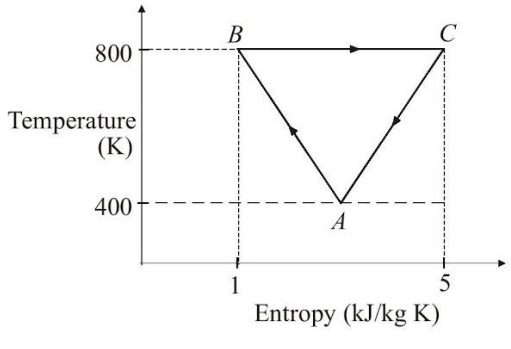
(A) Boiler and condenser for parallel flow (B) Boiler and condenser counter flow

(C) Boiler and condenser for both parallel flow and counter-flow

(D) Gas turbine for both parallel flow and counter-flow

Q.17 Steam at an initial enthalpy of 100 kJ/kg and inlet velocity of 100 m/s, enters an insulated horizontal nozzle. It leaves the nozzle at 200 m/s. The exit enthalpy (in kJ/kg) is_____.

Q.18 The thermal efficiency (in %) of the hypothetical heat engine cycle shown in the given figure is ___.



Q.19 The component of the Rankine cycle that leads to a relatively low cycle efficiency is

(A) Boiler (B) Pump (C) Turbine (D) Condenser

Q.20 If P_a and P_v denote respectively the partial pressure of dry air and that of water vapour in moist air, the specific humidity of air is given by

(A) $\frac{P_a}{P_a + P_v}$ (B) $\frac{P_v}{P_a}$ (C) $0.622\frac{P_v}{P_a}$ (D) $0.622\frac{P_v}{P_a + P_v}$

Q.21 A solid cylinder of diameter 100 mm and height 50 mm is forged between two frictionless flat dies to a height of 25 mm. The percentage change in diameter is

(A) 0 (B) 20.7 (C) 2.07 (D) 41.4

Q.22 In a rolling process, thickness of a strip is reduced from 4 mm to 3 mm using 300 mm diameter rolls rotating at 100 rpm. The velocity of the strip (in m/s) at the neutral point is _____.

Q.23 A medium carbon steel workpiece is turned on a Lathe at 50 m/min cutting speed, 0.8 mm/rev feed and 1.5 mm depth of cut. What is the rate of metal removal (in mm^3/min)?_____.

Q.24 The demand and forecast for February are 12000 and 10275, respectively. Using single exponential smoothing method (smoothing coefficient = 0.25), forecast for the month of march is:

(A) 431 (B) 9587 (C) 10706 (D) 11000

Q.25 Consider the following statements:

The break-even point increases if the

1. Fixed cost per unit increases
2. Variable cost per unit decreases
3. Selling price per unit decreases

Which of the above statements is/are correct?

(A) 1 only (B) 1 and 2 (C) 2 and 3 (D) 1 and 3

Q.26 to Q.55 carry two marks each.

Q.26 The area of the region in first quadrant enclosed between the curve $y = x^3$ and the line $y = x$ is_____.

Q.27 The decay rate of radium at any time t is proportional to its mass at that time. The mass is M_0 at time $t = 0$. The time when the mass will be halved is

(A) $\frac{\log 3}{3k}$ (B) $\frac{\log 2}{2k}$ (C) $\frac{\log 2}{k}$ (D) None of these

(where, k is constant)

Q.28 For a Binomial distribution, mean is 6 and variance is 2. The number of Bernoulli trials is _____.

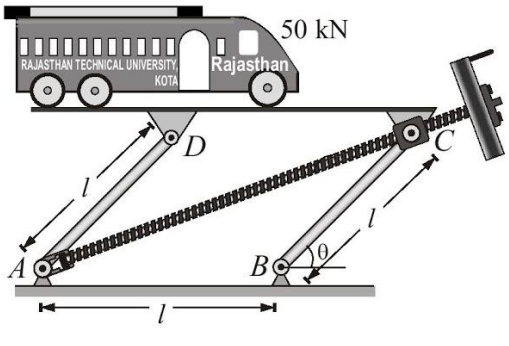
Q.29 The elevation of the load is controlled by the adjusting screw which connects joint A and C(see figure). The tensile force in adjusting screw AC is

(A) $\frac{100\cos\theta}{\sin\frac{\theta}{2}}$ kN

(B) $50\cos\theta$ kN

(C) $\frac{50\cos\theta}{\sin\frac{\theta}{2}}$ kN

(D) None of these

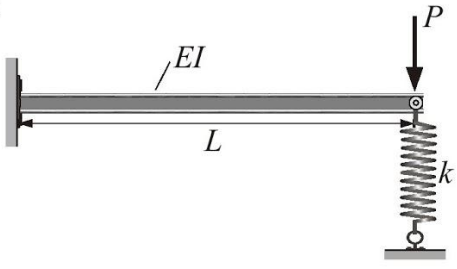


Q.30 A solid sphere of mass m and radius r rolls down a plane inclined at θ with the horizontal. The acceleration of the sphere will be

(A) $\frac{2}{3}g\sin\theta$ (B) $\frac{5}{7}g\sin\theta$ (C) $\frac{3}{7}g\sin\theta$ (D) None of these

Q.31 A beam is fixed at the left end and supported by a spring at the other end. The length of the beam is

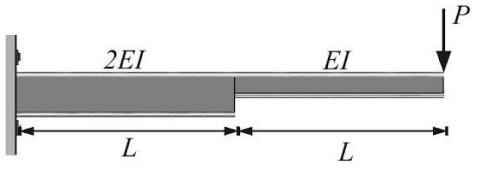
L and its flexural rigidity is EI. The spring constant is $k = \frac{3EI}{L^3}$. A vertical downward load P is applied at the right end. The deflection of the point under the load P is



(A) $\frac{PL^3}{9EI}$ (B) $\frac{PL^3}{6EI}$

(C) $\frac{2PL^3}{9EI}$ (D) $\frac{5PL^3}{9EI}$

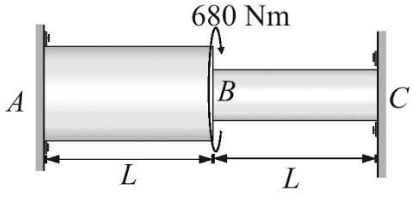
Q.32 A cantilever beam is constructed by two beams (with flexural rigidity EI and $2EI$) as shown in figure. The deflection under the load P is



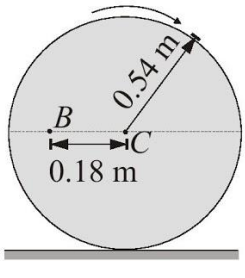
(A) $\frac{3}{2}\frac{PL^3}{EI}$ (B) $\frac{3}{7}\frac{PL^3}{EI}$

(C) $1.33\frac{PL^3}{EI}$ (D) None of these

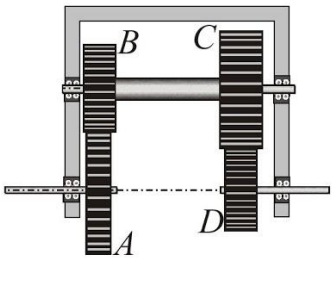
Q.33 A stepped circular shaft made of steel is rigidly fixed at two supports A and C as shown in the figure. A torque of 680 Nm is applied on the shaft at point B. The diameter of portion AB is twice that of portion BC. The magnitudes of torque reactions at supports A is_____.



Q.34 A wheel rolls without slipping as shown in figure. The vertical component of the velocity of point B (for this position) is 9 m/s directed upward. The velocity (in m/s) of its centre C is____.

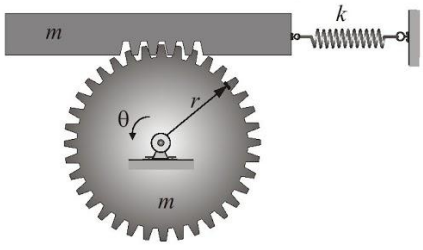


Q.35 Figure shown the reverted gear train. The number of teeth on gear A, B and C are 30, 20 and 30 respectively. If gear A rotates with speed 300 rpm, then the speed of gear D is_____.



Q.36 A system of rack-pinion-spring is shown in figure. The governing differential equation of the

system (considering the pinion to be a thin circular disc) is



(A) $\frac{d^2\theta}{dt^2}+\frac{2k}{3m}\theta=0$ (B) $\frac{d^2\theta}{dt^2}+\frac{2k}{m}\theta=0$ (C) $\frac{d^2\theta}{dt^2}+\frac{5k}{3m}\theta=0$ (D) $\frac{d^2\theta}{dt^2}+\frac{k}{m}\theta=0$

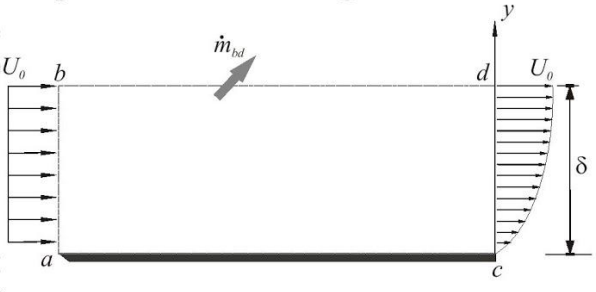
Q.37 A hole is to be punched in a 15 mm thick plate having an ultimate shear strength of 3 N/mm^2. If the allowable crushing stress in the punch is 6 N/mm^2, the diameter (in mm) of the smallest hole which can be punched is equal to_____.

Q.38 A steady laminar boundary layer is formed over a flat plate as shown in the figure

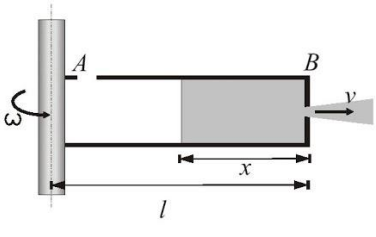
The free stream velocity of the fluid is U_0. The velocity profile at the inlet *a*-*b* is uniform, while that at a downstream location *c*-*d* is given by

$$u=U_0\left\{2\left(\frac{y}{\delta}\right)-\left(\frac{y}{\delta}\right)^2\right\}$$

The ratio of the mass flow rate, $\dot{m}_{bd}$, leaving through the horizontal section *b*-*d* to that entering through the vertical section *a*-*b* is _____.



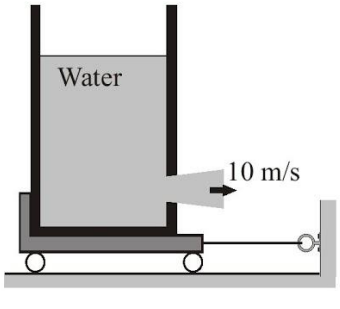
Q.39 A horizontal tube *AB* of length *l* rotates with a constant angular velocity ω about vertical axis as shown in figure. The tube is filled with ideal fluid. The end *A* of the tube is open, the closed end *B* has very small orifice. The velocity of fluid relative to tube is



(A) $v=\omega\sqrt{2lx-x^2}$ (B) $v=\omega\sqrt{l^2-x^2}$

(C) $v=\omega\sqrt{lx-x^2}$ (D) None of these

Q.40 A large tank is fixed to a cart as shown in figure. Water spurts from the tank through a 600 mm^2 nozzle at a velocity of 10 m/s. The water level in the tank is maintained constant by adding water through a vertical pipe. The tension (in N) in the wire holding the car stationary is_____.



Q.41 A 0.5 m thick large plane wall has its two surfaces kept at 300°C and 200°C. Thermal conductivity of the wall varies linearly with temperature and its values at 300°C and 200°C are 25 W/mK and 15 W/mK, respectively. Then the steady heat flux through the wall is

(A) 8 kW/m^2 (B) 5 kW/m^2 (C) 4 kW/m^2 (D) 3 kW/m^2

Q.42 A large concrete slab 1 m thick has one-dimensional temperature distribution $T(x) = 4 - 10x + 20x^2 + 10x^3$, where T is temperature and x is distance from one face towards other face of wall. If the slab material has thermal diffusivity of 2×10^{-3} m^2/h, what is the rate of change of temperature at the other face of the wall?

(A) 0.1 °C/h (B) 0.2 °C/h (C) 0.3 °C/h (D) 0.4 °C/h

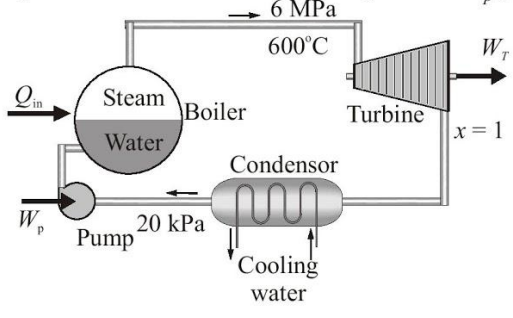
Q.43 A reversible heat engine receives 2 kJ of heat from a reservoir at 1000 K and a certain amount of heat from a reservoir at 800 K. It rejects 1 kJ of heat to a reservoir at 400 K. The net work output (in kJ) of the cycle is

(A) 0.8 (B) 1.0 (C) 1.4 (D) 2.0

Q.44 A liquid of mass m at temperature T_1 is mixed with an equal amount of the same liquid at temperature T_2. The specific heat of the liquid is c. The total entropy change due to the mixing process is:

(A) $2mc\ln\left(\frac{T_2}{T_1}\right)$ (B) $2mc\ln\left(\frac{T_1+T_2}{2\sqrt{T_1T_2}}\right)$ (C) $2mc\ln\left(\frac{T_1}{T_2}\right)$ (D) $2mc\ln\left(\frac{2\sqrt{T_1T_2}}{T_1+T_2}\right)$

Q.45 A simple ideal Rankine cycle shown in figure operates between the pressure limits of 20 kPa and 6 MPa, with a turbine inlet temperature of 600°C. The pump work W_p (in kJ/kg) is_____.



Steam power plant

Q.46 Air enters the compressor of an ideal gas-refrigeration cycle at 10 °C and 80 kPa. The maximum and minimum temperatures in cycle are 250 °C and –50 °C. The pressure ratio across the compressor in the cycle is (nearest)_____.

(A) 8.6 (B) 8.0 (C) 7.8 (D) 7.4

Q.47 A Brayton cycle operates with air entering the compressor at 100 kPa, 20°C, at a rate of 32.0 m^3/s, and air entering the turbine at 800 kPa, 1000°C. The power output of turbine is:

(A) 0.25 MW (B) 2.6 MW (C) 21.8 MW (D) 11.8 MW

Q.48 A cube shaped casting solidifies in 5 min. The solidification time (in min) for a cube of the same material which is 8 times heavier than the original casting, will be

(A) 10 (B) 20 (C) 24 (D) 40

Q.49 A 4 mm thick sheet is rolled with 300 mm diameter rolls to reduce thickness without any charge in its width. The friction coefficient at the work-roll interface is 0.1. The minimum possible thickness of the sheet that can be produced in a single pass is

(A) 1.0 mm (B) 1.5 mm (C) 2.5 mm (D) 3.7 mm

Q.50 A metal of strength coefficient 900 MPa and strain hardening exponent 0.40 used in a forging operation in which the work part is reduced in cross-sectional area by stretching. The average flow stress on the part is 600 MPa and initial cross-sectional area is 100 mm^2. The final cross-sectional area (in mm^2) of part is

(A) 43.1 (B) 74.3 (C) 69.6 (D) 95.2

Q.51 In an orthogonal cutting operation, the following observations are made:

Cutting force = 1470 N
Thrust force = 1589 N
Rake angle = 5°
Width of cut = 5.0 mm
Chip thickness before the cut = 0.6 mm
Chip thickness ratio = 0.38

The shear strength of the work material is:

(A) 87.6 MPa (B) 95.9 MPa (C) 133 MPa (D) None of these

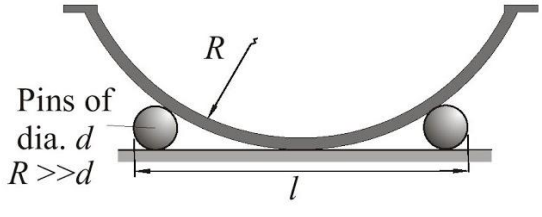
Q.52 A hole and mating shaft are to have a nominal assembly size of 50 mm. The assembly is to have a maximum clearance of 0.15 mm and a minimum clearance of 0.05 mm. The hole tolerance is 1.5 times the shaft tolerance. By using hole basis system. The limits of size for the hole is:

(A) $50^{+0.03}_{+0.00}$ mm (B) $50^{+0.02}_{+0.00}$ mm (C) $50^{+0.06}_{+0.00}$ mm (D) None of these

Q.53 The radius R of a pulley block is measured as shown in the figure is calculated by

(A) $R = \dfrac{l-d}{8d}$ (B) $R = \dfrac{(l-d)^2}{4d}$

(C) $R = \dfrac{(l-d)^2}{8d}$ (D) $R = \dfrac{(l-d)^2}{2d}$



Q.54 A company has four work centres A, B, C and D, with per day capacities of 450 units, 390 units, 360 units and 400 units respectively. The machines are laid down in order A, B, C and D and product has to be operated on all these machines for getting converted into finished product. The actual output turns out to be 306 units per day. What is the system efficiency?

(A) 68% (B) 78% (C) 80% (D) 85%

Q.55 There are five jobs, each of which has to go through the two machines A and B in the order AB. Processing times (in h) are given in the table:

Job	Machine A (h)	Machine B (h)
1	5	2
2	1	6
3	9	7
4	3	8
5	10	4

The sequence (order) for the five jobs that will minimise the total elapsed time for the completion of all the jobs, is

(A) 1→ 2 → 3→ 4 → 5 (B) 2→ 4→ 3→ 5→1 (C) 3→ 4→ 2→ 5→ 1 (D) None of these

Q.56 to Q.60 carry one mark each.

Q.56 He was one of my best_____and I felt his loss_____.

(A) friend, keenly (B) friends, keen (C)friend, keener (D) friends, keenly

Q.57 As the two speakers became increasingly agitated, the debate became_____.

(A) lukewarm (B) poetic (C) forgiving (D) heated

Q.58 If a and b are integers and $a-b$ is even, which of the following must always be even?

(A) ab (B) a^2+b^2+1 (C) a^2+b+1 (D) $ab-b$

Q.59 Seven machines take 7 minutes to make 7 identical toys. At the same rate, how many minutes would it take for 100 machines to make 100 toys?

(A) 1 (B) 7 (C) 100 (D) 700

Q.60 A rectangle becomes a square when its length and breadth are reduced by 10 m and 5 m, respectively. During this process, the rectangle loses 650 m^2 of area. What is the area of the original rectangle in square meters?

(A) 1125 (B) 2250 (C) 2924 (D) 4500

Q.61 to Q.65 carry two marks each.

Q.61 Given that a and b are integers and $a+a^2b^3$ is odd, which one of the following statements is correct?

(A) a and b are both odd (B) a and b are both even

(C) a is even and b is odd (D) a is odd and b is even

Q.62 From the time the front of a train enters a platform, it takes 25 seconds for the back of the train to leave the platform, while travelling at a constant speed of 54 km/h. At the same speed, it takes 14 seconds to pass a man running at 9 km/h in the same direction as the train. What is the length of the train and that of the platform in meters, respectively?

(A) 210 and 140 (B) 162.5 and 187.5 (C) 245 and 130 (D) 175 and 200

Q.63 Forty students watched films A, B and C over a week. Each student watched either only one film or all three. Thirteen students watched film A, sixteen students watched film B and nineteen students watched film C. How many students watched all three films?

(A) 0 (B) 2 (C) 4 (D) 8

Q.64 A wire would enclose an area of 1936 m^2, if it is bent into a square. The wire is cut into two pieces. The longer piece is thrice as long as the shorter piece. The long and the short pieces are bent into a square and a circle, respectively. Which of the following choices is closest to the sum of the areas enclosed by the two pieces in square metres?

(A) 1096 (B) 1111 (C) 1243 (D) 2486

Q.65 The perimeters of a circle, a square and an equilateral triangle are equal. Which one of the following statements is true?

(A) The circle has the largest area. (B) The square has the largest area.

(C) The equilateral triangle has the largest area. (D) All the three shapes have the same area.

Thanks

Want to know your score and question wise result with answers Key & solution (within 40 seconds at your email), **Please submit the answers in google form.** **(google form link given with this paper in email)** **otherwise** Email for google form link:

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Mock Test
GATE
MECHANICAL ENGINEERING

GATE Assessment Test

National Institute of Technology, Srinagar

Name of Institute

NAME OF CANDIDATE _____

Mobile No: ☐☐☐☐☐☐☐☐☐☐ State _____

Email: _____

ANSWER SHEET

Mechanical Engineering

	A	B	C	D
Q01				
Q02				
Q03				
Q04				
Q05				
Q06				
Q07				
Q08				
Q09				
Q10				
Q11				
Q12				
Q13				
Q14				
Q15				
Q16				
Q17				
Q18				
Q19				
Q20				
Q21				
Q22				
Q23				
Q24				
Q25				

	A	B	C	D
Q26				
Q27				
Q28				
Q29				
Q30				
Q31				
Q32				
Q33				
Q34				
Q35				
Q36				
Q37				
Q38				
Q39				
Q40				
Q41				
Q42				
Q43				
Q44				
Q45				
Q46				
Q47				
Q48				
Q49				
Q50				

	A	B	C	D
Q51				
Q52				
Q53				
Q54				
Q55				

General Aptitude

	A	B	C	D
Q56				
Q57				
Q58				
Q59				
Q60				
Q61				
Q62				
Q63				
Q64				
Q65				

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